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ABSTRACT

Designed primarily for educators, this paper focuses on the importance of water in the daily life of all living creatures and on the role marine and aquatic education plays in helping individuals understand this concept. Section one discusses the limitations of water, human impact on the global water system, and the need to protect it. Section two emphasizes the broad scope and interdisciplinary nature of marine and aquatic education and presents a definition and set of objectives with their implications. Section three explains how marine and aquatic education fits into the goals of environmental education and general education and how it can be incorporated into the existing curriculum by using an example approach, activity approach, multidisciplinary approach, or course. The final section suggests people, places, and materials which could provide resource information and assistance to Ohio educators and others. The three appendices elaborate upon this information. (DC)

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ED211346

ENVIRONMENTAL EDUCATION

Occasional Paper #6

Marine and Aquatic Education

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Office of Environmental Education
Ohio Department of Education
Columbus, Ohio 43215

August 1981

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The author began her career as a French and English teacher. She provided her students many interesting and worthwhile activities using the rich learning resources of the environment. These successful environmental education experiences led to extensive graduate studies in environmental education, teacher education, and curriculum development. Diane has developed a special interest in the global implications of environmental issues and how classroom teachers can improve their skills in this critical area of elementary and secondary education.

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FOREWORD

Marine and aquatic education has been a part of the curriculum in Ohio elementary and secondary schools for many years. Teachers and students have investigated ponds and streams, read about the early world explorers, studied the complexities of world trade and have been tuned in to such contemporary maritime happenings as the sinking of the Edmond Fitzgerald or the wreck of the oil tanker Torrey Canyon. This occasional paper is offered to Ohio educators to stimulate creative activities and thereby provide students an even deeper understanding and appreciation of the world of water.

The Ohio Department of Education is pleased to be cooperating with Ohio Sea Grant to bring to elementary and secondary students an increased awareness and understanding of marine and aquatic education.

The Office of Environmental Education invites and encourages comments on this paper.

WATER IN THE WORLD

Few of us realize to what extent we depend on the world of water in our daily lives. Every time we bite into a cream-filled cupcake, eat an ice cream cone, paint a wall or brush our teeth we are using a seaweed derivative which helps to maintain a creamy texture. When we feed our pet or eat a drumstick, we are benefiting from the use of fish meal in animal foods.

Oil is only one item for our cars which is shipped by water from overseas. The raw materials and parts for a single car come from over 70 different nations (1: 25). Consequently, the production and cost of land transportation are closely tied to the water transportation system.

Because of Lake Erie's effect on weather, the residents of Painesville, Ohio, have to shovel more inches of snow than the people living in Toledo. Even our language reflects the impact of water. Today's meanings for "making ends meet," "mind your p's and q's," or "skyscraper" bear little resemblance to their original maritime contexts.

The Limits to Water

A lack of awareness of our daily ties to water would pose little problem if we had unlimited quantities of water for domestic, industrial and agricultural use. But we do not. We are deceived by the vastness of the water world. Long before photographs from space showed the earth as a bluish marble, children were learning in school that three-fourths of our planet is covered by water. Few learn, however, that oceans, ice caps, and glaciers constitute 99.35 percent of that water (8: 11).

While the frozen water and the oceans are important in our lives, it is the remaining 0.65 percent which we use more directly for day-to-day activities.

ere lies another misconception. The limited amount of water would pose little problem if rain and rivers brought new water. But the earth is a closed system. There is essentially the same amount of water today as there was three billion years ago; we continue to use it over and over again. As we turn on the faucet in the morning to make a cup of coffee or mix orange juice, we assume that the water is safe to drink. Although we may know that it came through the local water treatment plant or filtered through the ground to our well, we seldom think beyond our local resources; yet, we should. As Anderson explains,

> The water you drank this morning fell as rain on Lake Michigan two weeks ago. Three months prior to that the water was evaporating from a lake in central Asia. Two months prior to that it was part of the water a Korean mother was using to bathe her infant daughter. Now you have used it to satisfy your thirst. Two hours from now it will leave you as urine and two months later it may be part of a summer rain falling on the streets of Paris (1:29).

Where was it before Korea and where will it go after Paris?

Pushing the Limits

We live in a global socie y which is pushing the limits of water through growth and demand. Increases in population, shifts in population from inland to coastal areas and rising consumption have led to increasing demands for water and water resources. Since water is limited in quantity and recycled, efforts to keep up with human needs have often resulted in detrimental impact on the water environment.

For example, increasing demands for food may lead to water shortages due to irrigation. Lowered water quality because of soil, fertilizer and pesticide run-off and the depletion of fish populations due to over-harvesting also produce negative impacts. This in turn will affect the physical, sociological and economic well-being of people in the future. Other demands for water and water resources (e.g. energy, recreation, natural resources, transportation, defense) lead to similar repercussions.

When the negative effects appear obvious or dramatic, some people may only express concern while others may take action to correct the problem. This is often the case, for instance, when people see oil covered birds dying as a result of an oil spill or blowout. However, the gradual deterioration of the water environment goes unnoticed by most. For example, more oil enters the oceans from improperly disposed waste oil from automobile crank cases and machines than from oil spills or blowouts. (7:286). The run-off of petroleum chemicals from automobiles and other land sources is approximately 24 times as great as petroleum pollution from offshore drilling (4:13). In addition, this less visible pollution often impacts more on the water environment since it usually affects the most productive area of the ocean, the coastal zone.

Protecting the Limits

Our existence depends upon careful, planned use of oceanic and fresh water resources. However, we are hindered in our efforts to protect and responsibly use the water environment by a lack of awareness about our daily dependence on water, limited knowledge about this important life support system and lack of understanding about how society affects the water

environment. The quality and quantity of future water resources depends upon correcting these deficiencies. Marine and aquatic education represents one effort to address this very difficult and complex task.

AN OVERVIEW OF MARINE AND AQUATIC EDUCATION

Marine and aquatic education evolved from the science education movement which was spurred by the launching of Sputnik I and the environmental movement which was marked by Earth Day in 1970. The scope and goals of marine and aquatic education encompass much more than its roots indicate.

Dimensions of Marine and Aquatic Education

Much of our daily life is dependent upon water. Marine and aquatic education must reflect this fact. The following list indicates some of the various dimensions of marine and aquatic education. It is not intended as a comprehensive outline but rather as a stimulus in thinking about the broad scope of marine and aquatic education.

Culture:	art, music, literature, heritage
Energy Sources:	oil, coal, wind, waves, tides, hydro, solar, thermal, nuclear
Human Impact:	pollution, development, over-use
Marine & Fresh Water Ecology:	lakes, ponds, rivers, swamps, estuaries, seas, oceans
Maritime and Naval History:	explorers, wars, shipbuilding, shipwrecks
Physical Forces:	wind, waves, currents, tides, erosion, coastal processes, crustal evolution
Properties of water:	physical, chemical
Recreation:	fishing, boating, swimming
Transportation and Commerce:	shipping, world trade, canals, ports, imports/exports
Uses of Water:	domestic, industrial, agricultural
Weather and Climate:	temperature, precipitation, wind directions

Efforts to educate people about the world of water should include these and other elements and how they relate to ecological, political, economic, sociological and technological concerns.

Definition and Objectives

With the foregoing material as a background, the question becomes, What is marine and aquatic education? Goodwin and Schaadt (4:6) wrote one of the most accepted definitions:

> Marine and aquatic education is that part of the total educational process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments.

The primary objectives of marine and aquatic education are:

* to develop a public which is aware of and knowledgeable about the proper use, protection and conservation of the oceans, coastal zones and fresh water resources and,

* to motivate people to take part in decisions affecting the sea and fresh water.

The major intent, therefore, is not to produce a nation of marine biologists, oceanographers or hydrologists, but to develop a citizenry which is "marine literate."

The above explanation raises three important points. First, by using the term "marine and aquatic education," the definition addresses the total water system. The popular term "marine education" fails to explicitly include fresh water along with salty (marine) water. In reality most marine educators include both; however, the major focus usually remains on the marine environment.

Second, the emphasis on the "total educational process" indicates that this is not restricted to formal education. Aquariums, zoos, nature centers and other environmental education centers offer many nonformal opportunities for the general public as well as students to participate in marine and aquatic education experiences. Organizations and governmental agencies provide programs, materials and assistance. In addition, the mass media help to increase awareness and knowledge through news coverage, television serials, feature articles and productions, public service announcements, and specialized publications.

Finally, the use of the word "education" emphasizes that this is not a course, subject area or discipline. Within formal education, marine and aquatic education must shed its image as science or marine science and become a theme which permeates the total curriculum. Students who read *Moby Dick* or *Pagoo*, write a report about the War of 1812, create their own fish recipes, estimate the average number of organisms in an estuary, sing sea chanteys, draw their favorite marine animal or investigate the effect of Lake Erie on climate are all involved in marine and aquatic education.

FORMAL EDUCATION

Although many individuals and organizations support marine and aquatic education through nonformal approaches, most of the emphasis and efforts focus on formal education, beginning in kindergarten and continuing through post secondary work. Marine and aquatic

education does not take the form of a course but rather that of a theme which draws upon appropriate methods and materials to complement and enhance existing educational goals and curricula. The following discussion first demonstrates how marine and aquatic education helps to meet the goals of environmental education and general education and then describes ways in which it can be incorporated into the existing curriculum.

Environmental Education

The basic aims of environmental education are to help individuals understand the biological, physical, social, economic and political dimensions of the natural and built environments and acquire the knowledge, skills and values to make responsible decisions related to the future quality of the environment. As one component of environmental education, marine and aquatic education helps to meet these goals in two ways.

First, water-related issues of concern to marine and aquatic education cannot be separated from concerns of other major components of environmental education. For example, the alternative energy sources studied in energy education all deal with water either directly (e.g. tides, waves, ocean thermal) or indirectly (e.g. nuclear, wind, solar). When world hunger is discussed in population studies, the misconception of the oceans as the future panacea for food and water shortages must be corrected. Pollution-related activities must indicate the limitations of ocean dumping and the dangers of improperly designed landfills.

Second, marine and aquatic education focuses on one of the major

life support systems—water—and its interrelationship with the other systems—air, soil and life. Environmental education addresses all four equally.

General Education

In a similar way, both environmental education and marine and aquatic education help to achieve the goals of general education. While people do not always agree on what constitutes these goals, the Association for Supervision and Curriculum Development published the following list (2:9-12) which represents one view of current thinking in this area. It may be used to demonstrate how marine and aquatic education contributes towards meeting many of the educational goals of general education.

Goals of General Education

1. Basic skills
2. Self-conceptualization
3. Understanding others
4. Using accumulated knowledge to interpret the world
5. Continuous learning
6. Mental and physical well-being
7. Participation in the economic world of production and consumption
8. Responsible societal membership
9. Creativity
10. Coping with change

These goals, or similar ones suggested by other educators, are inherent in the primary objectives of marine and aquatic education identified in the preceeding section. In order for individuals to become aware of and knowledgeable about the water environment and its related issues, they must learn and practice basic skills, use accumulated knowledge to interpret the world, and cope with changes in the water environment,

especially those that result from human impact. In order for individuals to take part in decisions affecting the sea and fresh water, they must understand how each person's decisions affect everyone else, exhibit responsible societal membership, and understand how their participation in the economic world of production and consumption affects the present and future water environment. Both of these major marine and aquatic education objectives require lifelong learning.

In this way, the goals of marine and aquatic education correspond closely to those of general education. Consequently, marine and aquatic education efforts may readily complement existing curricula designed to meet the goals of general education.

Incorporating Marine and Aquatic Education into the Existing Curriculum

Because of the interrelatedness of marine and aquatic education with general education and environmental education, it is reasonable to ask if we need another kind of education, especially when the field is already deluged with so many others (e.g. consumer education, global education, citizenship education, career education). The answer would be no if any educational efforts were adequately meeting the need for marine and aquatic education but they are not. Presently, schools appear to emphasize the importance of land over water as evidenced by a notable lack of water related examples, activities, units and courses in the existing curriculum. Water seems to be taken so much for granted that we fail to perceive the importance of it in the curriculum.

Marine and aquatic education uses a variety of approaches for incorporating water-related information, ideas and concerns into the curriculum. These may be broadly identified as the example approach, activity or unit approach, multidisciplinary theme approach, and specific courses. Since teaching styles, curriculums, and philosophies differ, educators may find one method more appropriate than another. In the end, a combination of these may lead to the best results.

With the example approach, teachers use water-related examples in place of or in addition to some of the land-oriented ones to teach the same skills or concepts. For instance, instead of adding and subtracting bushels of apples math students may be asked to add and subtract baskets of fish. Or they could solve story problems about fuel efficiency or distance-time rates of water transportation. For English, grammar exercises could contain sentences about water. Reading selections could include poems, stories, books and other pieces with water themes or settings. These kinds of substitutions and additions can easily be made in many subjects to increase awareness about marine and aquatic ideas without detracting from the teaching objectives of the discipline.

With the activity or unit approach, the teacher uses one or more marine and aquatic education activities or lessons to enhance and expand upon an existing water-related idea or topic. As students study transportation systems in Ohio and their impact on the state's development, they might construct a model of a lock system or use a water drainage map to decide where they would have located Ohio's canals. In a world history class, they could complete a unit on the role of the oceans in the spread

of civilization. The activity or unit approach increases awareness, knowledge and understanding by deliberately teaching about water as it relates to the subject area.

With the multidisciplinary approach, teachers and students use skills and content information from several disciplines to investigate a theme or topic. This method lends itself well to both individual and team teaching. Students studying an estuary, for example, would draw upon science, math, social studies and English as they use a water testing kit, calculate averages or percentages, read a topographical or aerial map, interview local people (hunters, fishers, industrialists), use dichotomous keys and field guides, read local newspapers for evidence of land use conflicts, and observe and record signs of animals. An individual teacher can lead this kind of study or a team of teachers might coordinate a study of the oceans. For example, students in an English class could read Pearl Buck's "The Big Wave" as they study the physical forces of water in a science class, debate coastal zone management issues in a social studies class, calculate the rate of erosion along the coastline in math class and draw seascapes in art class. By drawing upon several disciplines, students not only use a variety of skills and information but they also gain a more comprehensive understanding of the world of water.

Finally, some schools and teachers prefer specific courses on a marine related topic (e.g. oceanography, literature of the sea) or a one-time marine education week. While these contribute to the efforts of marine and aquatic education, they fail to include it as an integral part of the

total educational process as is possible with the example, activity, and multidisciplinary theme approach.

Regardless of the approaches used to incorporate marine and aquatic education into the existing curriculum, the success of any effort depends heavily upon teachers. Most educators have neither the time nor the resources to develop their own programs in marine and aquatic education. Fortunately, Ohio has many resources so that teachers do not have to "reinvent the keel."

PEOPLE, PLACES AND MATERIALS

Ohio has many organizations, agencies and institutions which provide a variety of services to educators including resource and curriculum materials, planning assistance, teacher education programs and field trips. Some of these relate to water in general while others emphasize places, topics or issues of special interest to Ohioans. For addresses and other sources of information, assistance and resource materials not listed below, see the appendices.

Ohio Sea Grant

Ohio Sea Grant is part of the National Sea Grant Program, which is a federal program committed to the better understanding, use, management, and protection of the resources of the seas and the Great Lakes. Similar to other state sea grant programs, Ohio Sea Grant has three components: research which investigates resource and management problems of Lake Erie and other water bodies; advisory services which convey these research findings to the public; and education which provides resource information and assistance to educators.

The Ohio Sea Grant Education Office directed the development and production of Oceanic Education Activities for Great Lakes Schools (OEAGLS--pronounced "eagles"). These 23 classroom activities for grades 5-9 cover a variety of topics including world shipping, oil spills, erosion, and the Great Lakes triangle. While many activities are science oriented, other subject areas included are geography, social studies, math, language arts, history, art and music. These allow students to better explore the economic, political, social, scientific and technological dimensions of the role of the Great Lakes and oceans in Ohio. Activity units usually take two to three class periods to complete. Materials include a teacher's guide and a student workbook which may be duplicated. In addition to the OEAGLS activities, the office distributes a quarterly newsletter entitled Middle Sea, conducts teacher workshops and courses, sponsors resource centers at three locations (Ohio State University, Bowling Green State University, University of Cincinnati) and provides consultation services.

Similar services are available from other Great Lakes sea grant programs. In particular, the Michigan Sea Grant Curriculum group has developed materials titled "Great Lakes Curriculum for Middle Schools." These are comprised of five individual units: The Sea Lamprey in the Great Lakes, Great Lakes Fishing in Transition, Water Quality, Great Lakes Urban Communities and Great Lakes Shipping. Complete units may take 10-30 class periods but most of the individual activities take one to three class periods. Materials include filmstrips and tapes, slides, simulation games, board games, wall maps and student materials for duplication.

Ohio Department of Education, Office of Environmental Education

For over 41 years, an environmental education consultant has provided assistance to Ohio teachers in elementary, secondary and teacher education. Curriculum and resource materials, consultation services, and pre- and in-service teacher programs focus on one or more of the interdisciplinary themes included within the broad scope of environmental education (e.g. energy, population, food, land use planning, ecology, conservation).

Since marine and aquatic education is also a component of environmental education, the Office of Environmental Education consultant has been federally designated as the marine education coordinator for the State of Ohio. In addition to the previously mentioned services, this person also co-directs several of the Ohio Sea Grant projects.

State Agencies

Two state agencies directly influence the use and management of water and water resources in Ohio. The Ohio Department of Natural Resources provides information and assistance about a variety of water-related topics including coastal zone management, fishing, watercraft safety, ground water, pond construction, glaciers and endangered aquatic species. The Ohio Environmental Protection Agency distributes brochures on public water supply and waste water. It also responds to inquiries about water regulations and their enforcement. Similar information is also available from the U.S. Environmental Protection Agency, Center for Environmental Research Information located in Cincinnati.

Universities and Colleges

Local institutions of higher education have two kinds of offerings useful to teachers. The first are content courses such as fresh water ecology, oceanography and marine biology. A directory of marine and aquatic content courses offered by Ohio colleges is available from the Ohio Sea Grant Education Office. The second are graduate and undergraduate method courses or workshops in environmental education and marine and aquatic education. In addition, university personnel and facilities may serve as a resource for teachers.

Other Organizations and Places

Numerous other resource people and places exist throughout the state. Some of these focus on features which are special for Ohio. For example, The Toledo Port Authority, the Great Lakes Historical Society and AmShip (American Shipbuilding Company) could be used to teach about Lake Erie, the Great Lakes and their connection to the Atlantic Ocean. The lock system on the Ohio River and the Ohio River Museum could also help teach about water transportation and ocean connections. Roscoe Village focuses on canals. Local zoos, aquariums, museums, parks, historical sites and environmental education centers may address local as well as general water-related topics. For more specific information, see Appendix C.

CONCLUSION

Ohio may not be located on the ocean but we are directly connected to the Atlantic and the rest of the world by the Great Lakes and the

Ohio River. In addition, we are indirectly connected in countless ways on a day-to-day basis. Our lives are dependent upon water and the future quality of our lives is dependent upon how well we understand, protect and conserve our water resources. Ohio has the people, places and resources for meeting the need for marine and aquatic education.

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APPENDIX A*

Sources of Information and Assistance

Educational Resource Information Center, Clearinghouse for Science, Mathematics and Environmental Education (ERIC/SMEAC). The Ohio State University, 1200 Chamber Road, Room 310, Columbus, Ohio, 43212. A microfiche computerized collection of research and resource documents of use to educators at all levels. ERIC is located in most university libraries. Over 1500 documents have marine education significance.

Marine Education Materials System (MEMS). Microfiche computerized collection of marine education material which is constantly being updated. Obtain "The Guide to Marine Education Materials" from Sea Grant Publications, VIMS, Gloucester Point, VA, 23602.

National Oceanic and Atmospheric Administration, Department of Commerce, Washington, D.C., 20230. For meteorological and oceanographic information, contact the Office of Public Affairs.

National Marine Education Association, Virginia Institute of Marine Science Education Center, Gloucester Point, VA, 23062. This office can direct you to regional organizations and individuals who can provide assistance. NMEA publishes Current: Journal of Marine Education which carries a wide range of marine education articles.

Office of Sea Grant, NOAA. 6010 Executive Boulevard, Rockville, MD., 20852. The Maryland office can give you information concerning the nearest Sea Grant program and relevant Sea Grant supported educational projects. The Sea Grant program is located in thirty states; supported by federal/state funding it promotes the wide use of marine resources through research, education and advisory services.

Ohio Department of Education. The state marine education coordinator, appointed by the chief state school officer, is available to conduct workshops, provide information and consult with educators. Office of Environmental Education, Ohio Department of Education, 65 S. Front Street, Room 811, Columbus, Ohio, 43215.

Ohio Department of Natural Resources, Fountain Square, Columbus, Ohio, 43224. For general information or educational assistance, contact the Office of Public Information and Education. For specific information, contact one of the divisions. (Geological Survey, Natural Areas and Preserves, Parks and Recreation, Soil and Water Districts, Water, Watercraft, Wildlife).

* Some of the information in this appendix was adapted from 5:5.

Ohio Environmental Protection Agency, 361 E. Broad Street, Columbus, Ohio, 43215. Contact the Public Interest Center, the Office of Public Water Supply or the Office of Wastewater Pollution Control.

Ohio Sea Grant. Three branches provide research and education information and assistance to Ohioans.

1) Ohio Sea Grant Program, Center for Lake Erie Area Research, 484 West 12th Avenue, Columbus, Ohio, 43210;
2) Ohio Sea Grant Extension Program located at the above address with Sea Grant area extension agents at three locations:
   a) Lorain County Extension Office, 1575 Lowell Street, Elyria, Ohio, 44035,
   b) Lake County Extension Office, 99 East Erie Street, Painesville, Ohio, 44077, and
   c) Fremont Area Extension Center, 1401 Walter Avenue, Fremont, Ohio, 43420; and
3) Ohio Sea Grant Education Office, 1945 N. High Street, Columbus, Ohio, 43210

U.S. Coast Guard. For information on boating and pollution control, contact Boating Safety, Ninth Coast Guard District Headquarters, Federal Office Building, Room 2061, 1240 E. 9th Street, Cleveland, Ohio, 44199.

U.S. Environmental Protection Agency, Center for Environmental Research and Information, 26 W. St. Clair, Cincinnati, Ohio 45268. Address inquiries to "Public Information."

APPENDIX B*

Resource Materials

Childrens' Literature-Passage to the Sea. N. Bagnall, 1980. Sea Grant/ Texas A&M, College Station, Texas, 77843. Gives ideas for hands-on activities for learning stations which focus on three children's books—one for primary, one for upper elementary, and one for middle school.

Coastal Problems and Resource Management: A Secondary Social Studies Course. Curriculum Research and Development Group, University of Hawaii, Honolulu. 1979. Materials include a book of readings, student worksheets and a simulation game called Ostrich Bay.

Great Lakes Curriculum for Middle Schools. Michigan Sea Grant Curriculum Team, c/o Dr. Paul Nowak, School of Natural Resources, Dana Building, University of Michigan, Ann Arbor, Michigan, 48109. Contains multi-disciplinary units on the sea lamprey, fishing, water quality, urban communities and shipping.

High School Marine Science Study Project (HMSS). Curriculum Research and Development Group, University of Hawaii, Honlulu, 1979. Contains 10 chapters of activities which focus on three themes: fluid earth, living ocean and technology.

Investigating the Marine Environment: A Sourcebook. H. M. Weiss and M. W. Dorseg, 1979. Three volumes. Project Oceanology, Avery Point, Groton, Connecticut, 06340.

Investigating the Marine Environment and Its Resources. V. Lien, 1979. Texas A&M Sea Grant University Program, College Station, Texas, 77843. Two volumes of interdisciplinary activities and information on the Gulf Coast.

Marine Organisms in Science Teaching. J. D. Hunt, ed. Texas A&M College Program, College Station, Texas, 77843. Contains supplemental, hands-on investigations for a laboratory-oriented science program for grades four through twelve.

Marine Science Education Project. University of Maryland Sea Grant Program, H. J. Patterson Hall, Room 1222, College Park, Maryland, 20742. Three titles are available: Food Webs in an Estuary, The American Oyster, and Tides and Marshes.

North Carolina Marine Education Project. UNC Sea Grant College Program, 105 1911 Building, NCSU, Raleigh, North Carolina, 27650. Five volumes covering specific topics like coastal geology and history.

* Some of information in this appendix was adapted from 5:5.

Northern New England Marine Education Project. 1979. Sea Grant/College of Education, University of Maine, Orono, Maine, 04469. Over fifteen volumes covering interdisciplinary topics like whales, art, aquaculture, ships and aquariums.

Ocean Related Curriculum Activities (ORCA). Sea Grant/Pacific Science Center/Sea Grant, 200 2nd Avenue North, Seattle, Washington, 98109. Over eight volumes covering specific topics from navigation to Indians to beaches.

Oceanic Education Activities for Great Lakes Schools. Ohio Sea Grant Education Office, The Ohio State University, 283 Arps Hall, 1945 N. High Street, Columbus, Ohio, 43210. Collection of twenty-three multidisciplinary activities for grades five through nine on topics like climate, erosion, pollution, shipping, and fish.

Project COAST. Sea Grant/University of Delaware, University of Delaware, 310 Willard Hall, Education Building, Newark, Delaware, 19711. Series of over 125 topic-oriented packages covering various topics such as dune dances, marine stories and oysters. 1974.

"Sensing the Sea." (Grades Two-Three) E. Odell-Fisher and R. N. Giese, 1978. Virginia Institute of Marine Science, Gloucester Point, Virginia, 23062. Contains hands-on elementary activities which focus on the characteristics of the coastal area and the life which exists there.

Smithsonian Estuarine Activities (SEA). S. P. Gucinski, ed., 1979. Smithsonian Institution, P.O. Box 28, Edgewater, Maryland, 21037. A series of activities investigating marshes and estuaries.

The Source Book of Marine Sciences. S. Dobkin, ed., 1980. Florida Oceanographic Society, 1212 Riverside Drive, Stuart, Florida, 33494. Laboratory experiments of the oceans.

Wet, Wild and Deep, the Physical Ocean. Institute for Marine and Coastal Studies/Sea Grant, USC, University Park, Los Angeles, California, 90007.

APPENDIX C*

Ideas for Field Trips and Other Educational Opportunities

Boat Rides

Canal Fulton: The St. Helena II, a full-size replica of a mule-drawn Ohio freight barge (in town on SR 93).
Cincinnati: Delta Queen and Mississippi, steamboat tours of the Ohio and Mississippi Rivers.
Cleveland: Goodtime II, sightseeing cruises on the Cuyahoga River and and harbor (departs from E. 9th Street Pier).
Coshocton: Monticello II, canal boat ride near Roscoe Village (on SR 16 and 83 at jct. U.S. 16).
Piqua: A mule-drawn canal boat ride at the Piqua Historical Area (off SR 66, 2½ miles north).
Zanesville: The Lorena Sternwheeler, a replica of a turn-of-the century sternwheeler on the Muskingum River (Putnam Landing dock on Muskingum Avenue, ¼ mile from south end of 6th Street Bridge).

Historical Sites

Coshocton: Roscoe Village, a restored 19th-century Ohio-Erie canal town (on SR 16 and 83 at jct. U.S. 16).
Garrettsville: Hopkins Old Water Mill (1804), an operating mill with authentically reproduced water wheel (in town on SR 82).
Put-in-Bay on South Bass Island in Lake Erie: Perry's Victory and International Peace Memorial, commemorates the Battle of Lake Erie during the War of 1812 (reached by automobile ferries from Catawba or Port Clinton).

Industry

Lorain: American Shipbuilding Company (AmShip Division) Lorain Yard, tours of shipbuilding and repair facilities (400 Colorado Avenue, 44052).
Painsville: Morton Salt Company Fairport Mine, tour of facilities (near mouth of Grand River).
Toledo: AmShip, see Lorain, (2245 Front Street, 43605).

Locks

Muskingum River: For information about locations, facilities and tours, contact Muskingum River Parkway, Parkway Office, Box 2806, Zanesville, Ohio, 43761.
Ohio River: For information about locations, facilities and tours, contact U.S. Army Corps of Engineers, Huntington District, Box 2127, Huntington, West Virginia, 25721.

* Some of the information in this appendix was adapted from the 1981 American Automobile Association Tour Book for Ohio.

Museums

Cleveland: Cleveland Museum of Natural History (Wade Oval in University Circle).
Cincinnati: Cincinnati Museum of Natural History (1720 Gilbert Avenue near the entrance to Eden Park).
Columbus: Center for Science and Industry (280 E. Broad Street).
Columbus: Ohio Historical Society (jct. I-71 and 17th Avenue).
Dayton: Dayton Musuem of Natural History (2629 Ridge Avenue).
Fairport Harbor: Fairport Marine Museum (129 2nd Street).
Marietta: Ohio River Museum and the W.P. Snyder, Jr., one of the first all-metal, steam powered towboats on the Ohio River (Washington and Front Streets).
Vermilion: Great Lakes Historical Society Museum (480 N. Main Street).

Natural Areas, Preserves and Parks

Many organizations own properties which contain lakes, streams, marshes, bogs, estuaries or other bodies of water. Some of these organizations provide opportunities for individualized exploration while others make available naturalists or other personnel for guided tours. For specific information contact:

Ohio Department of Natural Resources, the Divisions of Natural Areas and Preserves, Parks and Recreation or Wildlife, Fountain Square, Columbus, 43224.
The Ohio Historical Society, Interstate 71 and 17th Avenue, Columbus, 43211.
The Nature Conservancy, Ohio Chapter, 1504 West First Avenue, Columbus, 43212.
Local Parks (city, county, metro), nature centers, camps, environmental education centers, school land labs.

Ports

Ohio has ports at five locations: Ashtabula, Cleveland, Conneaut, Lorain and Toledo. Guided tours may be arranged at Cleveland and Toledo Port Authorities.

Zoos

Aurora: Sea World, family entertainment, school programs and teacher workshops (3 miles northwest on SR 43).
Cleveland: Cleveland Aquarium, marine and fresh-water plants and animals (off I-90 at E 72nd Street exit in Gordon Park).
Cleveland: Cleveland Metroparks Zoo (in Brookside Park with entrance off W. 25th Street).

Cincinnati: Cincinnati Zoological Gardens (exit 6 off I-75, following signs to Vine Street and Erkenbrecher Avenue).
Columbus: Columbus Zoo, with aquarium (at O'Shaughnessy Dam on SR 257 at 9990 Riverside Drive).
Sandusky: Cedar Point's Oceana, performing dolphins and aquazoo (reached by toll causeway off U.S. 6, 10 miles north of Ohio Turnpike exit 7).
Toledo: Toledo Zoological Park, with a large fresh-water aquarium (3 miles southwest on U.S. 24 at 2700 Broadway).
Youngstown: For Nature Center, semiaquatic terrarium and aquariums with indigenous fish, plants and crayfish.

Miscellaneous

Castalia: Blue Hole, artesian spring of azure water of unknown depth, trout exhibit, and fish (½ mile north on SR 269).
Kelleys Island in Lake Erie: resort, grapes, quarries, glacial grooves (by ferry from Sandusky or Marblehead).
Marblehead: resort, fishing center, light house, quarries.

OCCASIONAL PAPERS

This is the sixth in a series of papers designed to provide interested people with some current information about environmental education. The occasional paper format was chosen because it provides for rapid production and, therefore, timeliness. The varied topics of these papers will allow them to be distributed to different and specific audiences.

Other topics now being considered for publication are:

An Explanation of Appropriate Technology

School Land Laboratories: Their Use and Development

Resident Outdoor Education: Some Program Guidelines

Responsibilities of a School District Coordinator of Environmental Education

Suggestions for other topics will be welcome.

Authors for these papers will be Ohioans both in and out of the Ohio Department of Education and, therefore, the views expressed are those of the authors, and not necessarily those of the Ohio Department of Education.